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By: **Raquel C. West** 03/07/08 **Date**

Attorney Docket No. 2003P18697US

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:

Thilaka S. Sumanaweera, et al.

Serial No. 10/806,875

Filing Date: March 23, 2004

For: ULTRASOUND BREATHING WAVEFORM DETECTION SYSTEM AND METHOD

Examiner Ellsworth Weatherby

Group Art Unit No. 3768

Mail Stop: Appeal Brief – Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

TRANSMITTAL OF APPEAL BRIEF

Sir:

Transmitted herewith, in triplicate, is the APPEAL BRIEF in this application, with respect to the Notice of Appeal filed 01/14/2008.

Please charge the requisite fee for filing an Appeal Brief of $510.00 to our Deposit Account No. 19-2179. Please charge any additional fees or credit any over payment to our Deposit Account. A duplicate copy of this sheet is enclosed.

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Attorney Docket No. 2003P18697US

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APPEAL BRIEF (37 CFR 41.37)

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Dear Sir:

By the filing of this Appeal Brief in accordance with 37 CFR § 41.37, Appellants respectfully request reconsideration of the above-identified patent application by the Board of Patent Appeals and Interferences.

Real Party in Interest

The real party in interest is Siemens Medical Solutions USA, Inc., an organization having a place of business in Malvern, Pennsylvania.

Related Appeals and Interferences

There have not been and are no pending appeals, interferences, or judicial proceedings that may be related to, directly effect, or be directly affected by or have bearing on the Board's decision in this appeal.

Status of Claims

1. Claims 1-5, 7-13, and 15-21 are present and pending in the application.
2. Claims 1-5, 7-13, and 15-21 have been finally rejected.
3. The rejections of claims 1-5, 7-13, and 15-21 are being appealed.

Arguments are submitted below for claims 1-5, 7-13, and 15-21.

Status of Amendments

On October 5, 2007, an Amendment and Response, including an amendment to claim 8, was filed subsequent to the Final Office Action dated August 8, 2007. According to the Advisory Action dated December 13, 2007, the Amendment and Response was accepted but failed to place the application in condition for allowance.

Summary of Claimed Subject Matter

There are five (5) independent claims involved in this appeal: claims 1-2, 7, 12, and 16. In addition, there are fourteen (14) dependent claims involved in this appeal: claims 3-5, 8-11, 13, 15, and 17-21.

A. Independent Claims:

1. Independent claim 1 recites a method for detecting breathing cycle information with ultrasound (e.g., Figure 2; page 7, paragraph [0028]), comprising the steps of: obtaining ultrasound data acquired over a period of time (e.g., pages 7-8, paragraph [0029]; page 8, paragraph [0030]; pages 8-9, paragraph [0031]); determining at least a first portion of a breathing cycle as a function of the ultrasound data (e.g., page 9, paragraph [0032]; pages 9-13, paragraphs [0033]-[0043]); and displaying a breathing cycle waveform comprising the first portion (e.g., pages 3-4, paragraph [0016]; page 15, paragraph [0050]).

2. Independent claim 2 recites a method for detecting breathing cycle information with ultrasound (e.g., Figure 2; page 7, paragraph [0028]), comprising the steps of: obtaining ultrasound data acquired over a period of time and responsive to contrast agents (e.g., pages 7-8, paragraph [0029]; pages 8-9, paragraph [0031]); and

determining at least a first portion of a breathing cycle as a function of the ultrasound data. (e.g., page 9, paragraph [0032]; pages 9-13, paragraphs [0033]-[0043]).

3. Independent claim 7 recites a method for detecting breathing cycle information with ultrasound (e.g., Figure 2; page 7, paragraph [0028]), comprising the steps of: obtaining ultrasound data acquired over a period of time (e.g., pages 7-8, paragraph [0029]; page 8, paragraph [0030]; pages 8-9, paragraph [0031]); determining at least a first portion of a breathing cycle as a function of the ultrasound data (e.g., page 9, paragraph [0032]; pages 9-13, paragraphs [0033]-[0043]); and identifying the first portion as a function of a trend in the breathing cycle (e.g., Figure 5; pages 13-14, paragraph [0044]).

4. Independent claim 12 recites a system for detecting breathing cycle information with ultrasound (e.g., Figure 1; pages 4-7, paragraphs [0017]-[0027]), comprising: a memory operable to store frames of ultrasound data acquired over a period of time (page 5-6, paragraph [0021]); a processor operable to determine at least a first portion of a breathing cycle as a function of the ultrasound data (e.g., pages 6-7, paragraphs [0024]-[0027]); and a display operable to display a breathing cycle waveform (page 6, paragraph [0023]).

5. Independent claim 16 recites a method for detecting a cycle with ultrasound data (e.g., Figure 2; page 7, paragraph [0028]), comprising the steps of: (a) tracking motion of a plurality of frames of ultrasound data with respect to a reference frame of ultrasound data (e.g., pages 9-12, paragraphs [0033]-[0039]); (b) calculating a cyclic parameter as a function of the tracked motion (e.g., pages 12-13, paragraphs [0040]-[0043]); (c) identifying a first portion of the cycle as a function of the cyclic parameter (e.g., pages 13-14, paragraph [0044]); (d) repeating (a), (b) and (c) for each of a plurality of subsequent cycles (e.g., Figure 2; page 14, paragraph [0045]); and (e) resetting the reference frame of data for each of the plurality of subsequent cycles as a first frame of ultrasound data corresponding to the first portion of the cycle (page 14, paragraph [0045]; pages 14-15, paragraph [0047]).

Dependent Claims:

6. Dependent claim 3 recites the method of claim 1 wherein (b) comprises determining a motion parameter of a current frame of data relative to a reference frame of data (e.g., pages 9-12, paragraphs [0033]-[0039]).

7. Dependent claim 4 recites the method of claim 3 wherein (b) comprises determining the motion parameter as a function of a plurality of local regions in the current frame of data relative to the reference frame of data (e.g., pages 9-12, paragraphs [0034]-[0039]).

8. Dependent claim 5 recites the method of claim 1 wherein (b) comprises determining a cost function value as a function of time, the cost function value associated with motion between a plurality of frames of data (e.g., pages 12-13, paragraphs [0040]-[0043]).

9. Dependent claim 8 recites the method of claim 7 wherein (c) comprises identifying a minimum of the breathing cycle (e.g., Figure 5; pages 13-14, paragraph [0044]).

10. Dependent claim 9 recites the method of claim 1 wherein (b) comprises determining the first portion as a function of a first reference frame of ultrasound data and a first subsequent frame of ultrasound data (e.g., page 9, paragraph [0033]); further comprising: (d) identifying reoccurrence of the first portion of the breathing cycle (e.g., pages 13-14, paragraph [0044]); and (e) repeating (b) with a second reference frame of ultrasound data associated with the reoccurrence of the first portion (e.g., page 14, paragraph [0045]).

11. Dependent claim 10 recites the method of claim 1 further comprising: (d) repeating (b) for each cycle of the breathing cycle with a different reference frame for each breathing cycle (e.g., page 14, paragraph [0045]); and wherein (b) comprises tracking motion for each breathing cycle as a function of the reference frame for each breathing cycle (e.g., page 9, paragraph [0033]; page 13, paragraph [0043]).

12. Dependent claim 11 recites the method of claim 10 further comprising: (e) morphing frames of ultrasound data within each breathing cycle to the reference frame for the corresponding breathing cycle (e.g., pages 16-17, paragraphs [0051]-[0052]).

13. Dependent claim 13 recites the system of claim 12 wherein the processor is operable to determine a motion parameter of a plurality of frames of ultrasound data relative to a reference frame of data (e.g., page 7, paragraphs [0025]).

14. Dependent claim 15 recites the system of claim 12 wherein the processor is operable to identify the first portion as a function of a trend in the breathing cycle (e.g., page 7, paragraphs [0026]).

15. Dependent claim 17 recites the method of claim 16 wherein (a) comprises tracking the motion as a function of a plurality of local regions (e.g., pages 9-12, paragraphs [0034]-[0039]).

16. Dependent claim 18 recites the method of claim 16 wherein (b) comprises calculating a cost as a function of an amount of motion of each of the plurality of frames of ultrasound data relative to the reference frame of data (e.g., pages 12-13, paragraphs [0040]-[0043]).

17. Dependent claim 19 recites the method of claim 16 further comprising: (f) morphing frames of data for each cycle relative to the reset reference frame for the corresponding cycle (e.g., pages 16-17, paragraphs [0051]-[0052]).

18. Dependent claim 20 recites the method of claim 16 wherein (c) comprises identifying the first portion in a breathing cycle (e.g., page 7, paragraph [0026]; page 9, paragraph [0032]; page 13, paragraph [0042]).

19. Dependent claim 21 recites the method of claim 16 wherein (a) comprises tracking motion in B-mode frames of data (e.g., page 5, paragraph [0020]; pages 8-9, paragraphs [0031] and [0033]).

Grounds of Rejection to be Reviewed on Appeal

The ground of rejection on Appeal is:

1. The rejection of claims 1-4, 7, 12-13, and 15 under 35 U.S.C. § 103(a) as being unpatentable over *Von Behren, et al.* (U.S. Patent Application Publication 2005/0107704).

2. The rejection of claim 5 under 35 U.S.C. § 103(a) as being unpatentable over *Von Behren, et al.* in view of *Jackson, et al. '543* (U.S. Patent Application Publication 2005/0096543).

3. The rejection of claim 8 under 35 U.S.C. § 103(a) as being unpatentable over *Von Behren, et al.* in view of *Sui, et al.* (U.S. Patent Application Publication 2005/0203395).

4. The rejection of claim 9 under 35 U.S.C. § 103(a) as being unpatentable over *Von Behren, et al.* in view of *Jackson '017* (U.S. Patent 6,673,017).

5. The rejection of claim 10 under 35 U.S.C. § 103(a) as being unpatentable over *Von Behren, et al.* in view of *Jackson '017* and further in view of *Jackson, et al. '660* (U.S. Patent 6,193,660).

6. The rejection of claim 11 under 35 U.S.C. § 103(a) as being unpatentable over *Von Behren, et al.* in view of *Jackson '017* and *Jackson, et al. '660* and further in view of *Jago, et al.* (U.S. Patent 6,117,081).

7. The rejection of claims 16-17 and 20-21 under 35 U.S.C. § 103(a) as being unpatentable over *Jackson '017* in view of *Jackson, et al. '660*. The rejection of claim 18 under 35 U.S.C. § 103(a) as being unpatentable over *Jackson '017* in view of *Jackson, et al. '660* and further in view of *Jackson, et al. '543*.

8. The rejection of claim 19 under 35 U.S.C. § 103(a) as being unpatentable over *Jackson '017* in view of *Jackson, et al. '660* and further in view of *Jago, et al.*

Argument

1. Argument with Respect to Grounds of Rejection Nos. 1-8

Reversal of the Examiner's rejection of claims 1-5, 7-13, and 15-21 is respectfully requested for the reasons set forth below.

MPEP § 2142 states that "[to] establish a prima facie case of obviousness ... the prior art reference ... must teach or suggest all the claim limitations." *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991). However, the combination of the cited references fails to teach, either expressly or inherently, each and every element recited in claims 1, 3-5, 7-13, and 15-21 discussed below. Moreover, it would not have been obvious to combine the teachings of the references to include each and every element of the rejected claims, including claim 2.

(a) Rejection of Independent Claims 1 and 12

Independent claims 1 and 12 recite, *inter alia*, displaying a breathing cycle waveform. *Von Behren, et al.* do not teach or suggest at least this feature.

In the Final Office Action dated August 8, 2007, the Examiner asserts that displaying a cycle waveform overlay is disclosed in paragraph [0019] of *Von Behren, et al.* Paragraph 19 of *Von Behren, et al.* discloses a processor operable to match a waveform to variations of an imaging parameter and operable to determine phase and amplitude characteristics from the matched waveform. Paragraph 19 also discloses that the processor is operable to *use* the phase and/or amplitude information for generating an image, an overlay or a portion of images. The images or overlay of images *are not the waveform* but are images generated using amplitude and/or phase information *from* the waveform. There is no teaching or suggestion of displaying any waveform, let alone a breathing cycle waveform comprising a first portion.

Also, *Von Behren, et al.* focus on phase analysis of a heart cycle, not a breathing cycle. (*Von Behren, et al.*, paragraph [0025]). In the Final Office Action dated August 8, 2007, the Examiner argues that it would have been obvious to one of ordinary skill in the art to modify *Von Behren, et al.* to monitor a breathing cycle. However, heart movement is drastically more rapid and different than movement of other organs based on breathing. *Von Behren, et al.* focus on identifying a varying image parameter regarding heart movement. (*Von Behren, et al.*, paragraphs [0024]-[0025]). The teachings of *Von Behren, et al.* are developed to deal with the unique pattern of heart motion, including ECG signal, the variation in activation time of different parts of the heart, and heart anatomy accessible from acoustic windows. Some portions of the heart contract at different times than other portions for a given heart beat, and one feature of *Von Behren, et al.* is to determine B-mode values for different spatial locations of the heart during a heart beat, not a breathing cycle. There is no phase consideration for the lungs and no indication that phase of operation of the lungs indicates lung health. One of ordinary skill in the art would not modify the heart phase analysis features of *Von Behren, et al.* to monitor a breathing cycle because organ movement based on breathing and a breathing cycle are quite different than heart movement.

Based on either of the reasons above, *Von Behren, et al.* do not teach or suggest at least "displaying a breathing cycle waveform comprising the first portion" and "a display operable to display a breathing cycle waveform," as required by independent claims 1 and 12, respectively. The claimed invention would not have been obvious in view of the cited reference. Accordingly, reversal of these grounds of rejection is respectfully requested.

(b) Rejection of Independent Claim 2

Independent claim 2 recites, *inter alia*, "(a) obtaining ultrasound data acquired over a period of time and responsive to contrast agents" and "(b) determining at least a first portion of a breathing cycle as a function of the ultrasound data."

In the Final Office Action dated August 8, 2007, the Examiner argues that the claimed features are taught by pointing to Paragraph [0022] of *Von Behren, et al.* Paragraph [0022] of *Von Behren, et al.* states that data is acquired for spatial locations; in one embodiment, the data acquired is ultrasound data, such as B-mode or intensity data, and in another alternative embodiment, contrast agent data may be used.

However, *Von Behren, et al.* concern phase and amplitude analysis based on a heart cycle, not a breathing cycle. (*Von Behren, et al.*, Abstract, paragraphs [0016] and [0021]). In the Final Office Action, the Examiner argues that it would have been obvious to modify *Von Behren, et al.* to monitor a breathing cycle. Yet, contrast agent imaging is used in regards to the circulatory system, *i.e.*, the heart cycle, not a breathing cycle. Contrast agents were specifically developed in order to be injected into the circulatory system. A person of ordinary skill would not use the teaching of contrast agent of *Von Behren, et al.* in regards to determining a portion of a breathing cycle as a function of the ultrasound data.

Based on the reasons above, *Von Behren, et al.* do not teach or suggest at least "obtaining ultrasound data acquired over a period of time and responsive to contrast agents" and "(b) determining at least a first portion of a breathing cycle as a function of the ultrasound data," as required by independent claim 2. The claimed invention would not have been obvious in view of the cited reference. Accordingly, reversal of this ground of rejection is respectfully requested.

(c) Rejection of Independent Claim 7

Independent claim 7 recites, *inter alia*, "(b) determining at least a first portion of a breathing cycle as a function of the ultrasound data; and (c) identifying the first portion as a function of a trend in the breathing cycle." *Von Behren, et al.* do not teach or suggest at least these features.

In the Final Office Action dated August 8, 2007, the Examiner argues that the claimed features are taught by pointing to Paragraph [0025] of *Von Behren, et al.* Paragraph [0025] of *Von Behren, et al.* discloses a B-mode variation as a function of time over about two heart cycles and matching a sine wave to the variation. However, there is no teaching of identifying a portion of a cycle, let alone a breathing cycle, as a function of a *trend* in the cycle. Matching B-mode variation over time does not disclose identifying a portion of a cycle as a function of a trend.

Furthermore, *Von Behren, et al.* concern phase and amplitude analysis based on a heart cycle, not a breathing cycle. (*Von Behren, et al.*, Abstract, paragraphs [0016] and [0021]). Heart movement is drastically more rapid and different than movement of other organs based on breathing. *Von Behren, et al.* focus on identifying a varying image parameter regarding heart movement. (*Von Behren, et al.*, paragraphs [0024]-[0025]). Some portions of the heart contract at different times than other portions for a given heart beat, and one feature of *Von Behren, et al.* is to determine the brightness of intensity that varies cyclically as a function of time during a heart beat, not a breathing cycle. One of ordinary skill in the art would not modify the phase analysis features of *Von Behren, et al.* to monitor a breathing cycle because organ movement based on breathing and a breathing cycle are quite different than heart movement.

Based on either of the reasons above, *Von Behren, et al.* do not teach or suggest at least "(b) determining at least a first portion of a breathing cycle as a function of the ultrasound data; and (c) identifying the first portion as a function of a trend in the breathing cycle," as required by independent claim 7. The claimed invention would not have been obvious in view of the cited reference. Accordingly, reversal of this ground of rejection is respectfully requested.

(d) Rejection of Independent Claim 16

Independent claim 16 recites, *inter alia*, "(b) calculating a cyclic parameter as a function of the tracked motion," (c) identifying a first portion of the cycle as a function of the cyclic parameter," and "(e) resetting the reference frame of data for each of the plurality of subsequent cycles as a first frame of ultrasound data corresponding to the first portion of the cycle." The combination of *Jackson '017* and *Jackson, et al. '660* does not teach or suggest at least these features.

Column 5, lines 53-67 of *Jackson, et al. '017* disclose determining temporal offsets of frames of a cycle with respect to temporal positions relative to a base physiological cycle. Temporal offsets of different cycles are determined for interleaving by comparing a frame of a cycle with a corresponding frame of a base cycle. Column 6, lines 10-13 of *Jackson, et al. '017* disclose that offsets may be determined relative to a beginning or end of the cycle, as a position along a time axis with reference to another frame or using other processes. In other words, *Jackson, et al. '017* determine where in a representative heart cycle a given frame from an actual heart cycle would be located for interleaving together frames from many heart cycles into a collection of frames representing a single heart cycle.

Jackson, et al. '660 deal with spatial considerations of a region of interest. Column 6, lines 36-65 of *Jackson, et al. '660* disclose correlating one frame of data to another frame of data within a same set of frames to determine the position of a region of interest designator to ultimately estimate motion of anatomy. Also, column 8, lines 7-9 of *Jackson, et al. '660* mention, in regards to the use of past estimates, that triggering may be used to estimate cyclical movement associated with a cycle.

However, there is no teaching or suggestion of identifying a first portion of a cycle as a function of a cyclic parameter that was calculated from tracked motion of frames. *Jackson, et al. '660* disclose a region of interest designator that is determined from estimated motion of anatomy associated with a region of interest between two frames of ultrasound data, but that is not the same as *identifying a first portion of a cycle* as a function of the cyclic parameter. *Jackson, et al. '660* deal with spatial, not temporal, considerations. Also, the estimation of cyclical movement disclosed by *Jackson, et al. '660* is based on mere triggering, not the correlation of frames. (*Jackson, et al. '660*,

column 8, lines 7-9). Furthermore, *Jackson, et al. '017* determine portions of physiological cycles using ECG (*Jackson, et al. '017*, column 5, lines 20-24), which is not the same as identifying a first portion of a cycle as a function of a cyclic parameter that was calculated from tracked motion of frames.

Additionally, the combination of the references does not teach or suggest *resetting* a reference frame of data for *each* of a plurality of subsequent cycles as a *first frame* of ultrasound data corresponding to a *first portion* of the cycle. *Jackson, et al. '017* merely disclose that another frame rather than a corresponding frame can be used when *determining offsets* between a cycle and a base cycle, but that does not mean different reference frames are set for each of a plurality of subsequent cycles as a first frame of ultrasound data corresponding to a first portion of a cycle. Determining temporal offsets using frames in *Jackson, et al. '017* and correlating frames within a set of frames for a motion indication in *Jackson, et al. '660* are not the same as determining a portion of a cycle as a function of different reference frames. There is no teaching or suggestion of using different reference frames that correspond to a reoccurrence of a first portion of a cycle.

Based on the reasons above, the combination of *Jackson '017* and *Jackson, et al. '660* does not teach or suggest at least "(e) resetting the reference frame of data for each of the plurality of subsequent cycles as a first frame of ultrasound data corresponding to the first portion of the cycle," as required by independent claim 16. The claimed invention would not have been obvious in view of the cited references. Accordingly, reversal of this ground of rejection is respectfully requested.

(e) Rejection of Claims 3-5 and 9-11

Claims 3-5 and 9-10 depend from and include the limitations of claim 1. The arguments regarding claim 1 appropriately apply to the dependent claims as well.

Furthermore, claim 9 recites, *inter alia*, "wherein (b) comprises determining the first portion as a function of a first reference frame of ultrasound data and a first subsequent frame of ultrasound data," "(d) identifying reoccurrence of the first portion of the breathing cycle," and "(e) repeating (b) with a second reference frame of ultrasound data associated with the reoccurrence of the first portion." Claim 10 recites, *inter alia*,

"(d) repeating (b) for each cycle of the breathing cycle with a different reference frame for each breathing cycle." The combination of *Von Behren, et al.*, *Jackson '017*, and *Jackson, et al. '660* does not teach or suggest at least these features.

Column 5, lines 53-67 of *Jackson, et al. '017* disclose determining temporal offsets of frames of a cycle with respect to temporal positions relative to a base physiological cycle. Temporal offsets of different cycles are determined for interleaving by comparing a frame of a cycle with a corresponding frame of a base cycle. Column 6, lines 10-13 of *Jackson, et al. '017* disclose that offsets may be determined relative to a beginning or end of the cycle, as a position along a time axis with reference to another frame or using other processes. Also, column 6, lines 36-65 of *Jackson, et al. '660* disclose correlating one frame of data to another frame of data within a same set of frames to determine the position of a region of interest designator to ultimately estimate motion of anatomy. Also, column 8, lines 7-9 of *Jackson, et al. '660* mention, in regards to the use of past estimates, that triggering may be used to estimate cyclical movement associated with a cycle.

However, there is no teaching or suggestion of determining a first portion of a breathing cycle based on frames of ultrasound data. For example, *Jackson, et al. '017* disclose using ECG, not frames of ultrasound data, to determine portions of physiological cycles. (*Jackson, et al. '017*, column 5, lines 20-24). *Jackson, et al. '017* disclose determination of temporal offsets using frames and *Jackson, et al. '660* disclose correlation of frames for motion indication, but that is not the same as determining a portion of a breathing cycle as a function of a reference frame. Also, the estimation of cyclical movement disclosed by *Jackson, et al. '660* is based on mere triggering, not the correlation of frames.

Furthermore, there is no teaching or suggestion of repeating the determination of the first portion of a breathing cycle with a different reference frame of ultrasound data associated with the reoccurrence of the first portion. *Jackson, et al. '017* merely disclose that another frame rather than a corresponding frame can be used when *determining offsets* between a cycle and a base cycle, but that does not mean a second different reference frame is set to determine the first portion of a breathing cycle. Determining temporal offsets using frames in *Jackson, et al. '017* and correlating frames

within a set of frames for a motion indication in *Jackson, et al. '660* are not the same as determining a portion of a breathing cycle as a function of different reference frames.

Also, it would not make sense to combine the features of *Jackson, et al. '017* with *Von Behren, et al. Von Behren, et al.* disclose determining phase information for a plurality of spatial locations and determining B-mode variation during a heart beat. (*Von Behren, et al.*, paragraphs [0024]-[0025]). On the other hand, *Jackson, et al. '017* disclose determining temporal offsets of frames of a cycle with respect to frames of a base physiological cycle. (*Jackson, et al. '017*, column 5, lines 53-67). The temporal offset data of *Jackson, et al. '017* would be of no use to the features of *Von Behren, et al.* because the temporal information would not add to or aid the spatial phase analysis. Common sense would not direct one to combine the references as suggested by the Examiner.

Claim 11 recites, *inter alia*, "(e) morphing frames of ultrasound data within each breathing cycle to the reference frame for the corresponding breathing cycle." In the Final Office Action dated August 8, 2007, the Examiner asserts that the combination of *Von Behren, et al.*, *Jackson '017*, *Jackson, et al. '660,* and *Jago, et al.* would teach the claimed feature.

It would not make sense to combine *Jago, et al.* with *Von Behren, et al., Jackson '017*, and *Jackson, et al. '660* because *Jago, et al.* deals with spatial compounding. (*Jago, et al.*, column 1, lines 15-27). Spatial compound imaging is performed by rapidly acquiring a series of partially overlapping component image frames from independent spatial directions (*Jago, et al.*, column 1, lines 15-27). However, *Von Behren, et al., Jackson '017*, and *Jackson, et al. '660* are interested in minimizing motions or correcting for motions while imaging from one position, not rapidly acquiring images at different angles. Common sense would not direct one to combine the references.

Accordingly, reversal of these grounds of rejection is respectfully requested.

(f) Rejection of Claim 8

Claim 8 depends from and includes the limitations of claim 7. The arguments regarding claim 7 appropriately apply to the dependent claim as well.

Furthermore, claim 8 recites, *inter alia*, "wherein (c) comprises identifying a minimum of the breathing cycle." The combination of *Von Behren, et al.* and *Sui, et al.* does not teach or suggest at least this feature.

This limitation is allegedly shown in claim 21 of *Sui, et al.* However, claim 21 of *Sui, et al.* discloses identifying a frame index corresponding to a frame of data where a substantial maximum is identified. However, there is no mention of identifying a *minimum* of a breathing cycle.

Accordingly, reversal of this ground of rejection is respectfully requested.

(g) Rejection of Claims 13 and 15

Claims 13 and 15 depend from and include the limitations of claim 12. The arguments regarding claim 12 appropriately apply to the dependent claims as well. Accordingly, reversal of these grounds of rejection is respectfully requested.

(h) Rejection of Claims 17-21

Claims 17-21 depend from and include the limitations of claim 16. The arguments regarding claim 16 appropriately apply to the dependent claims as well.

Furthermore, claim 19 recites, *inter alia*, "(f) morphing frames of data for each cycle relative to the reset reference frame for the corresponding cycle." In the Final Office Action dated August 8, 2007, the Examiner asserts that the combination of *Jackson '017*, *Jackson, et al. '660,* and *Jago, et al.* would teach the claimed feature.

It would not make sense to combine *Jago, et al.* with *Jackson '017* and *Jackson, et al. '660* because *Jago, et al.* deals with spatial compounding. (*Jago, et al.*, column 1, lines 15-27). Spatial compound imaging is performed by rapidly acquiring a series of partially overlapping component image frames from independent spatial directions (*Jago, et al.*, column 1, lines 15-27). Yet, *Jackson '017*, and *Jackson, et al. '660* are interested in minimizing motions or correcting for motions while imaging from one position, not rapidly acquiring images at different angles. Common sense would not direct one to combine the references.

Accordingly, reversal of these grounds of rejection is respectfully requested.

Conclusion

In conclusion, Appellants respectfully submit that the rejections raised by the Examiner have been overcome for at least the reasons set forth above. Accordingly, reversal of all grounds of rejection is respectfully requested.

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Date: 3-7-08

Claims Appendix

1. A method for detecting breathing cycle information with ultrasound, the method comprising:

(a) obtaining ultrasound data acquired over a period of time;

(b) determining at least a first portion of a breathing cycle as a function of the ultrasound data; and

(c) displaying a breathing cycle waveform comprising the first portion.

2. A method for detecting breathing cycle information with ultrasound, the method comprising:

(a) obtaining ultrasound data acquired over a period of time and responsive to contrast agents; and

(b) determining at least a first portion of a breathing cycle as a function of the ultrasound data.

3. The method of Claim 1 wherein (b) comprises determining a motion parameter of a current frame of data relative to a reference frame of data.

4. The method of Claim 3 wherein (b) comprises determining the motion parameter as a function of a plurality of local regions in the current frame of data relative to the reference frame of data.

5. The method of Claim 1 wherein (b) comprises determining a cost function value as a function of time, the cost function value associated with motion between a plurality of frames of data.

7. A method for detecting breathing cycle information with ultrasound, the method comprising:

(a) obtaining ultrasound data acquired over a period of time;

(b) determining at least a first portion of a breathing cycle as a function of the ultrasound data; and

(c) identifying the first portion as a function of a trend in the breathing cycle.

8. The method of Claim 7 wherein (c) comprises identifying a minimum of the breathing cycle.

9. The method of Claim 1 wherein (b) comprises determining the first portion as a function of a first reference frame of ultrasound data and a first subsequent frame of ultrasound data;

further comprising:

(d) identifying reoccurrence of the first portion of the breathing cycle; and

(e) repeating (b) with a second reference frame of ultrasound data associated with the reoccurrence of the first portion.

10. The method of Claim 1 further comprising:

(d) repeating (b) for each cycle of the breathing cycle with a different reference frame for each breathing cycle; and

wherein (b) comprises tracking motion for each breathing cycle as a function of the reference frame for each breathing cycle.

11. The method of Claim 10 further comprising:

(e) morphing frames of ultrasound data within each breathing cycle to the reference frame for the corresponding breathing cycle.

12. A system for detecting breathing cycle information with ultrasound, the system comprising:

a memory operable to store frames of ultrasound data acquired over a period of time;

a processor operable to determine at least a first portion of a breathing cycle as a function of the ultrasound data; and

a display operable to display a breathing cycle waveform.

13. The system of Claim 12 wherein the processor is operable to determine a motion parameter of a plurality of frames of ultrasound data relative to a reference frame of data.

15. The system of Claim 12 wherein the processor is operable to identify the first portion as a function of a trend in the breathing cycle.

16. A method for detecting a cycle with ultrasound data, the method comprising:

(a) tracking motion of a plurality of frames of ultrasound data with respect to a reference frame of ultrasound data;

(b) calculating a cyclic parameter as a function of the tracked motion;

(c) identifying a first portion of the cycle as a function of the cyclic parameter;

(d) repeating (a), (b) and (c) for each of a plurality of subsequent cycles; and

(e) resetting the reference frame of data for each of the plurality of subsequent cycles as a first frame of ultrasound data corresponding to the first portion of the cycle.

17. The method of Claim 16 wherein (a) comprises tracking the motion as a function of a plurality of local regions.

18. The method of Claim 16 wherein (b) comprises calculating a cost as a function of an amount of motion of each of the plurality of frames of ultrasound data relative to the reference frame of data.

19. The method of Claim 16 further comprising:

(f) morphing frames of data for each cycle relative to the reset reference frame for the corresponding cycle.

20. The method of Claim 16 wherein (c) comprises identifying the first portion in a breathing cycle.

21. The method of Claim 16 wherein (a) comprises tracking motion in B-mode frames of data.

Evidence Appendix

None

Related Proceedings Appendix

None